EP II DTV product function test

1. INTRODUCTION

1.1. Purpose

Testing was performed on the TE Connectivity (TE) Economy Power II connector system to determine its conformance to the requirements of Product Specification 108-2297, Revision B.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of TE Connectivity (TE) Economy Power II connector system. Testing was performed at the Shanghai Electrical Components Test Laboratory. The test file number for this testing is TP-22-00068-RECORD.

1.3. Conclusion

All part numbers listed in Paragraph 1.5 conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-2297, Revision B.

1.4. Product Description

TE Connectivity (TE) Economy Power II connector system are designed to accept 16 – 22 AWG wires and are available in 2 – 12 position configurations

1.5. Test Specimens

Test Set	Quantity	Part Number	Description
1, 2, 3, 5, 7, 8, 9	5	1-2371377-1	EP II plug housing, 11P, GWT
	150	2377991-1	EP-II CONTACT LANCELESS with 18AWG
	5	1-2384269-1	11P Unshroud Header Full Pin, boss, GWT
	5	1-2377130-1	EP II plug housing, 11P, non-GWT
	5	1-2384273-1	11P Unshroud Header Full Pin, boss, non-GWT
	5	2371377-8	EP II plug housing, 8P, GWT
	5	2367724-8	EP3.96 Shroud Header with boss, GWT, 8P
4	10	2377991-1	EP-II CONTACT LANCELESS with 18AWG
	10	2377991-1	EP-II CONTACT LANCELESS with 20AWG
	10	2377991-1	EP-II CONTACT LANCELESS with 22AWG
	10	2377997-1	EP-II CONTACT LANCELESS with 16AWG
	10	2377997-1	EP-II CONTACT LANCELESS with 18AWG
5	5	1-2371377-1	EP II plug housing, 11P, GWT
	5	1-2384269-1	11P Unshroud Header Full Pin, boss, GWT
	5	1-2377130-1	EP II plug housing, 11P, non-GWT
	5	1-2384273-1	11P Unshroud Header Full Pin, boss, non-GWT
	5	2371377-8	EP II plug housing, 8P, GWT
	5	2367724-8	EP3.96 Shroud Header with boss, GWT, 8P

6	5	1-2371377-1	EP II plug housing, 11P, GWT
	5	1-2377130-1	EP II plug housing, 11P, non-GWT
	110	2377991-1	EP-II CONTACT LANCELESS with 18AWG
10, 11	5	1-2384269-1	11P Unshroud Header Full Pin, boss, GWT
	5	1-2384273-1	11P Unshroud Header Full Pin, boss, non-GWT
	5	2367724-8	EP3.96 Shroud Header with boss, GWT, 8P

Figure 1

1.6. **Test Sequence**

Test or Examination	Test Group(a)										
	1	2	3	4	5	6	7	8	9	10	11
	Test Sequence(b)										
Initial examination of product	1	1	1	1	1	1	1	1	1	1	1
Low Level Contact Resistance (LLCR)	4,10	2,7					2,4	2,4	2,4		
Insulation resistance			2,6								
Withstanding voltage			3,7								
Temperature rise vs current		3,8									
Random vibration	6	6									
Mechanical shock	7										
Durability	5										
Mating force	2,8										
Unmating force	3,9										
Crimp tensile				2							
Contact insertion force						2					
Contact retention force			8			3					
Connector locking strength					2						
Thermal shock			5								
Humidity/temperature cycling		4	4								
Temperature life		5									
Salt spray							3				
Hydrogen sulfide								3			
Ammonia									3		
Solderability										2	
Resistance to Soldering Heat											2
Final examination of product	11	9	9	3	3	4	5	5	5	3	4

NOTE
a) See Paragraph 1.5.
b) Numbers indicate sequence in which tests shall be performed.

Figure 2

1.7. Environmental Conditions

Unless otherwise stated, the following environmental conditions prevailed during testing:

- Temperature: 15°C to 35°C
- Relative Humidity: 20% to 80%

2. SUMMARY OF TESTING

2.1. Initial Examination of Product – All Test Groups

A Certificate of Conformance stating all specimens submitted for testing were representative of normal production lots and met the requirements of the applicable product drawing was provided. Where Specified, specimens were visually examined, and no evidence of physical damage detrimental to product performance was observed.

2.2. Low Level Contact Resistance (LLCR) – Test Groups 1, 2, 7, 8 & 9

All initial low level contact resistance readings were less than the initial maximum requirement of 10 milliohms; and all final measurements were less than the final maximum requirement of 20 milliohms. Refer to Figure 3 for the resistance summary data (data does not include wire bulk).

Test Group	Number of Data points	Low Level Contact Resistance in milliohms					
		Initial			Final		
		Min	Max	Mean	Min	Max	Mean
1	150	1.40	1.95	1.60	1.53	2.24	1.71
2	150	1.36	2.02	1.75	1.54	4.27	2.67
7	150	1.43	2.04	1.71	1.09	2.54	1.69
8	150	1.45	1.89	1.75	1.50	2.69	1.95
9	150	1.44	1.99	1.76	1.36	2.25	1.79

Figure 3

2.3. Insulation resistance – Test Group 3

All initial insulation resistance measurements were greater than the minimum requirement of 1000 megohms. All final insulation resistance measurements were greater than the minimum requirement of 500 megohms. Refer to Figure 4 for the summary data.

Test Group	Number of Data points	Insulation Resistance in megohms					
		Initial			Final		
		Min	Max	Mean	Min	Max	Mean
3	5	2010000	8570000	4430000	35900	141600	74400

Figure 4

2.4. Withstanding voltage – Test Group 3

There were no withstanding voltage breakdowns, or flashover, and the leakage current did not exceed 5.0 milliamperes, when subjected to a test potential of 1500 volts AC for 60 seconds.

2.5. **Temperature Rise vs. Current – Test Group 2**

All temperature rises vs. current measurements recorded had a temperature rise less than 30 °C when energized at a single current level (7.5A). Refer to Figure 5 for the summary data.

Test Group	Number of Data points	Temperature Rise in °C					
		Initial			Final		
		Min	Max	Mean	Min	Max	Mean
2_Unshroud header_11P	5	13.9	20.0	17.4	18.6	26.5	23.7
2_Shroud header_8P	5	14.5	19.4	16.6	19.1	26.8	21.9

Figure 5

2.6. **Random Vibration – Test Group 1 & 2**

No discontinuities were detected during vibration. Following vibration, no cracks, breaks, or loose parts on the specimens were visible. Specimens were energized during vibration testing.

2.7. **Mechanical shock – Test Group 1**

No discontinuities were detected during mechanical shock. Following mechanical shock testing, no cracks, breaks, or loose parts on the specimens were visible.

2.8. **Durability – Test Group 1**

No physical damage occurred to the specimens as a result of mating and unmating the specimens 15 times.

2.9. **Mating force – Test Group 1**

All mating force measurements were less than the maximum requirement of 107.8N(Unshroud header) and 78.4N(Shroud header). Refer to Figure 6 for the summary data.

Test Group	Number of Data points	Mating force in N					
		Initial			Final		
		Min	Max	Mean	Min	Max	Mean
1_Unshroud header_11P	5	67.6	82.2	76.5	50.0	64.4	58.3
1_Shroud header_8P	5	52.5	63.8	57.6	36.2	44.2	41.2

Figure 6

2.10. **Unmating force – Test Group 1**

All unmating force measurements were greater than the minimum requirement of 9.9N(Unshroud header) and 7.2N(Shroud header). Refer to Figure 7 for the summary data

Test Group	Number of Data points	Unmating force in N					
		Initial			Final		
		Min	Max	Mean	Min	Max	Mean
1_Unshroud header_11P	5	89.2	102.5	97.4	78.7	95.1	88.3
1_Shroud header_8P	5	75.4	92.1	82.4	61.1	79.3	70.2

Figure 7

2.11. **Crimp Tensile – Test Group 4**

All crimp tensile measurements were greater than the minimum requirements of 100N for 16 AWG, 89 N for 18 AWG, 62.3N for 20 AWG, 44.5 N for 22 AWG.

2.12. **Contact insertion force – Test Group 6**

All contact insertion force measurements were less than the minimum requirement of 6.9 N. Refer to Figure 8 for the summary data.

Test Group	Number of Data points	Contact insertion force in N		
		Min	Max	Mean
6_Non-GWT	10	3.8	6.3	4.8
6_GWT	10	3.9	5.8	4.4

Figure 8

2.13. **Contact retention force – Test Group 4 & 6**

All contact retention force measurements were greater than the minimum requirement of 29.4N. Refer to Figure 7 for the summary data.

Test Group	Number of Data points	Contact retention force in N					
		Initial			After humidity/temperature cycling		
		Min	Max	Mean	Min	Max	Mean
6_non-GWT	10	50.4	63.0	55.7			
6_GWT	10	45.1	63.4	53.6			
4_non-GWT	10				32.9	40.1	35.6
4_GWT	10				37.6	47.0	41.8

Figure 7

2.14. **Connector locking strength – Test Group 5**

All connector locking strength measurements were greater than the minimum requirement of 49 N. Refer to Figure 8 for the summary data

Test Group	Number of Data points	Connector locking strength in N		
		Min	Max	Mean
5_Unshroud header_11P	5	73.4	86.6	81.4
5_Shroud header_8P	5	100.9	107.7	104.1

Figure 8

2.15. **Thermal shock – Test Group 3**

No evidence of physical damage was visible as a result of exposure to thermal shock.

2.16. **Humidity/temperature Cycling – Test Group 2 & 3**

No evidence of physical damage was visible as a result of exposure to humidity-temperature cycling.

2.17. **Temperature Life – Test Group 2**

No evidence of physical damage was visible as a result of exposure to temperature life.

2.18. **Salt spray – Test Group 7**

No evidence of physical damage was visible as a result of exposure to salt spray.

2.19. **Hydrogen sulfide – Test Group 8**

Post test visual examination of the test specimens showed no physical damage as a result of exposure to a H_2S environment.

2.20. **Ammonia – Test Group 9**

Post test visual examination of the test specimens showed no physical damage as a result of exposure to an ammonia environment.

2.21. **Solderability – Test Group 10**

All of test specimens get more than 95% coverage, when the specimens are exposed to a wave soldering heat profile having a peak temperature of 245°C.

2.22. **Resistance to Soldering Heat – Test Group 11**

No evidence of physical damage detrimental to product performance was visible as a result of exposure to a wave soldering heat profile having a peak temperature of 260°C.

2.23. **Final Examination of Product – All Test Groups**

Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

3. TEST METHODS

3.1. **Initial Examination of Product**

A Certificate of Conformance was issued stating that all specimens in this test package were produced, inspected, and accepted as conforming to product drawing requirements, and were manufactured using the same core manufacturing processes and technologies as production parts.

3.2. **Low Level Contact Resistance (LLCR)**

Contact resistance measurements at low level current were made using a four terminal measuring technique. The test current was maintained at 100 mA maximum with a 20 mV maximum open circuit voltage. All wire bulk was removed from the measurements. Refer to Figure 4 for a detailed drawing of the measurement points.

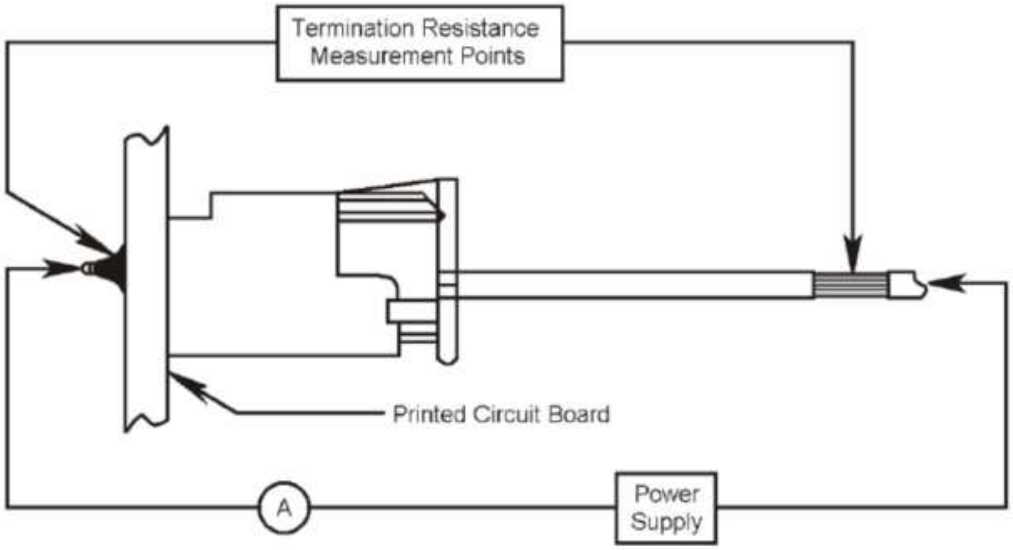

Figure 4 – Low Level Contact Resistance Measurement Points

3.3. **Insulation resistance**

A potential of 500 VDC was applied between adjacent contacts of unmounted, mated connectors and held for two minutes. Readings were recorded after two minutes.

3.4. **Withstanding voltage**

A potential of 1500 VAC was applied between adjacent contacts of unmounted, mated connectors at a rate of 500 volts per minute and held for one minute. The leakage current was set for 5.0 milliamps.

3.5. Temperature Rise vs. Current

The specimens were energized at various current levels and loading densities with DC current while the temperature rise was measured. The initial temperature rise data was used to establish the F-factor able values, and the final data (on the largest wire size) was used to establish the base rated current curve. Measurements were recorded once stabilization occurred (when the temperature rise of three consecutive readings taken at five minutes intervals did not differ by more than 1°C).

3.6. Random Vibration

The test specimens were subjected to a random vibration test. The parameters of this test condition are specified by a random vibration spectrum with excitation frequency bounds of 20 and 500 Hertz (Hz). The spectrum remains flat at 0.02 G^2/Hz from 20 Hz to the upper bound frequency of 500 Hz. The root-mean square amplitude of the excitation was 3.10 GRMS. The test specimens were subjected to this test for 15 minutes in each of the three mutually perpendicular axes, for a total test time of 45 minutes per test specimen. The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes.

3.7. Mechanical shock

The test specimens were subjected to a mechanical shock test. The parameters of this test condition are a half-sine waveform with an acceleration amplitude of 30 gravity units (g's peak) and a duration of 11 milliseconds. Three shocks in each direction were applied along the three mutually perpendicular axes of the test specimens, for a total of eighteen shocks. The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes.

3.8. Durability

Durability was performed by mating and unmating the specimens 15 times by hand. The cycle rate did not exceed 500 cycles per hour.

3.9. Mating force

The specimens were fixed in the manner fixture. The crosshead was lowered at a rate of 0.5in/min until the specimens were fully mated.

3.10. Unmating force

Prior to testing, the latches on the connector housings were rendered inoperable. The specimen header mounted to a PCB was secured to an X-Y table and the connector housing was held in a vice mounted to the load cell. The load cell was raised at a rate of 0.5in/min until the connector housing was removed from the header. The maximum force required to remove the connector housing form the header was recorded.

3.11. Crimp Tensile

Specimens were held in a slotted plate and goal post fixture with a slotted plate slot width of 0.065 inch. The slotted plate and goal post was mounted to an X-Y table. The wire lead was secured to an air jaw mounted to the load cell and raised at a rate of 25.4mm/min until the wire was removed from the crimp. The maximum load required to remove the wire from the contact, and the failure method was recorded.

3.12. Contact insertion force

Connector housings were secured to an X-Y table in a manner that would not prevent the contact retainer feature from operating while the contact was inserted into the housing. The contacts were trimmed of excessive wire bulk as close to the wire insulation crimp without damaging the crimp. The contacts were then inserted into the connector housing using a drill rod attached to the load cell. The contacts were inserted at a rate of 0.5 in/min until the contact was fully inserted. The maximum force required to insert the contact into the connector housing was recorded.

3.13. Contact retention force

Contact retention was measured by removed the contact from housing. The maximum load required to remove the contact from the housing, and the failure reading was recorded.

3.14. Connector locking strength

Prior to testing, the connector housing lip, opposite the side of the connector locking mechanism, was removed to provide a flush surface for mounting into a vice. The connector housings were secured by two vices mounted to an X-Y table. The connector housings were held in the vices in a manner that would not influence the connector locking mechanism during testing (one vice on each side of the connector locking mechanism). The header was secured in a vice attached to the load cell mounted to the crosshead. The crosshead was raised at a rate of 0.5 in/min until the header was removed form the connector housing. The maximum force required to separate the connector housing from the header was recorded.

3.15. Thermal shock

Mated specimens were subjected to 10 cycles of thermal shock with each cycle consisting of 30 minute dwells at -55°C and 105°C

3.16. Humidity/temperature Cycling

Mated specimens were exposed to 10 cycles of humidity-temperature cycling. Each cycle lasted 24 hours and consisted of cycling the temperature between 25°C and 65°C at 80 to 100% RH. Specimens were preconditioned with 10 cycles of durability prior to exposure.

3.17. Temperature Life

Mated specimens were exposed to a temperature of 105°C for 500 hours.

3.18. Salt spray

Specimens were hung from horizontal rods using fishing line attached to one end of the specimen. The test specimens were subjected to a 5% salt concentration environment for a period of 48 hours. At the completion of the exposure period the specimens were rinsed off with tap water, gently blown with compressed air to remove excess water then oven dried at 38°C for approximately 3 hours.

3.19. Hydrogen sulfide

Mated specimens were subjected to a 3±1 ppm H_2S gas concentration maintained at 40°C ± 2°C for 96 hours.

3.20. **Ammonia**

Mated specimens were subjected to a 3% ammonia solution for 7 hours.

3.21. **Solderability**

Prior to testing, mounting the specimen in a suitable holder, the portion of the surface specified was immersed in flux at room temperature for 5 s to 10 s. Excess flux was immediately drained off by standing the specimen vertically on clean filter paper for 5 s to 20 s. The specimen was then immersed at a speed of 25.6 mm per second to the specified depth in the molten solder (245±5 ℃) and held in this position for 5s then withdrawn at the same rate. The specimens were then given a visual examination using a microscope at 20X magnification.

3.22. **Resistance to Soldering Heat**

The specimen was then immersed at a speed of 25.6 mm per second to the specified depth in the molten solder (Soldering temperature: 260+0/-5℃) and held in this position for 5~7s then withdrawn at the same rate. The specimens were then given a visual examination using a microscope at 20X magnification.

3.23. **Final Examination of Product**

Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.